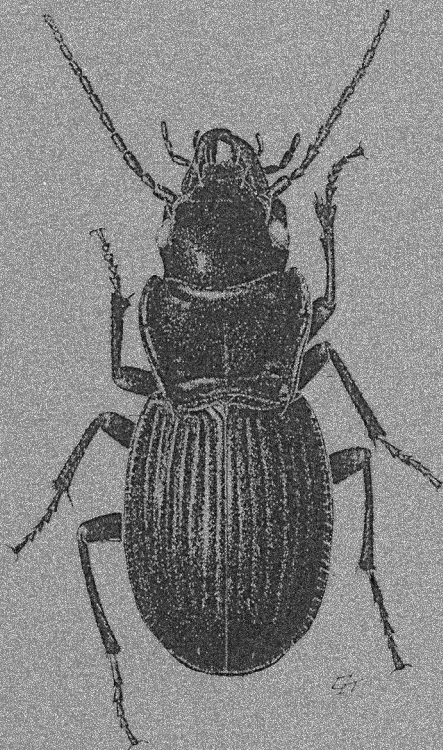


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Cover: The carabid beetle genus *Nurus* has about 10 large, heavy-bodied species which occur along the eastern seaboard of Australia from northern NSW to north Qld. They live in spiral burrows which they excavate with their mandibles. Prey is ambushed from the burrow entrance at night. Females brood their eggs and first instar larvae in the burrow. *Nurus brevis* Motschulsky, 1865 occurs near Lismore and is listed as rare and endangered by NSW legislation. Illustration by Geoff Thompson.

THE INSECT FAUNA INHABITING *UROMYCLADIUM* (UREDINALES) RUST GALLS ON SILVER WATTLE (*ACACIA DEALBATA*) IN TASMANIA

R. BASHFORD

Forestry Tasmania, GPO Box 207, Hobart, Tas 7001

Email: dick.bashford@forestrytas.com.au

Abstract

This study identifies the insect species utilising *Uromycladium* galls growing on *Acacia dealbata* in Tasmania and examines the relative abundance and seasonality of species using the galls as a food resource. Regular collections of galls were made over a 14 month period and the insects reared from them. The distribution of the 32 insect species reared from *U. tepperianum* galls from 13 sites in Tasmania is presented. *U. tepperianum* and *U. notabile* are recorded on *Acacia riceana* for the first time. The rare tineid, *Erechthias ancistrosema* Turner, was reared from galls at one site. Some observations on the biology and habitat of the moth are noted.

Introduction

Acacia dealbata (Link), a widely distributed wattle species in Tasmania, is often attacked by the uredineine rust fungus *Uromycladium tepperianum* (Sacc.) McAlpine. The biology of the fungus was described by Morris (1987). The commercial growth of *A. dealbata*, a valued tree species for veneer and pulpwood production in Tasmania and potentially a fast-growing general timber tree in many parts of the world, is impeded by two biotic factors. Defoliation by the fire-blight beetle *Acacicola orphana* (Erichson) (Chrysomelidae) (Elliott 1978) and branch decline caused by fungi of the genus *Uromycladium* restrict planting of this species.

This study had the aim of documenting the insects utilising *Uromycladium* galls as a contribution to the knowledge base for the production of this timber tree. Very young stressed trees or older declining trees are most susceptible with the number of galls per tree often increasing annually over many years, causing branch death and final demise of trees (Morris 1997). Over 100 species of *Acacia* have been recorded supporting this pathogen (Gathe 1971). The galls are utilized by many insect species, as both a food resource for immature and adult insects as well as a refuge for some transient species. A total of 32 insect species was reared from *U. tepperianum* galls collected at 13 sites in Tasmania. Collections were also made of *U. notabile* (Ludw.) McAlpine and new host records of this species and *U. tepperianum* on the Tasmanian endemic *Acacia riceana* Henslow are documented.

Materials and methods

Galls were collected from three sites on at least three occasions and from ten other sites on an opportunistic basis, throughout the range of *A. dealbata* in Tasmania (Fig. 1). At the three main sites collections were made over a 14 month period. These were Blackmans Bay (6 collections), Triabunna (5 collections) and Burnie (3 collections). Collected galls were transported to the laboratory in a car fridge at 8°C in individual, perforated plastic bags.

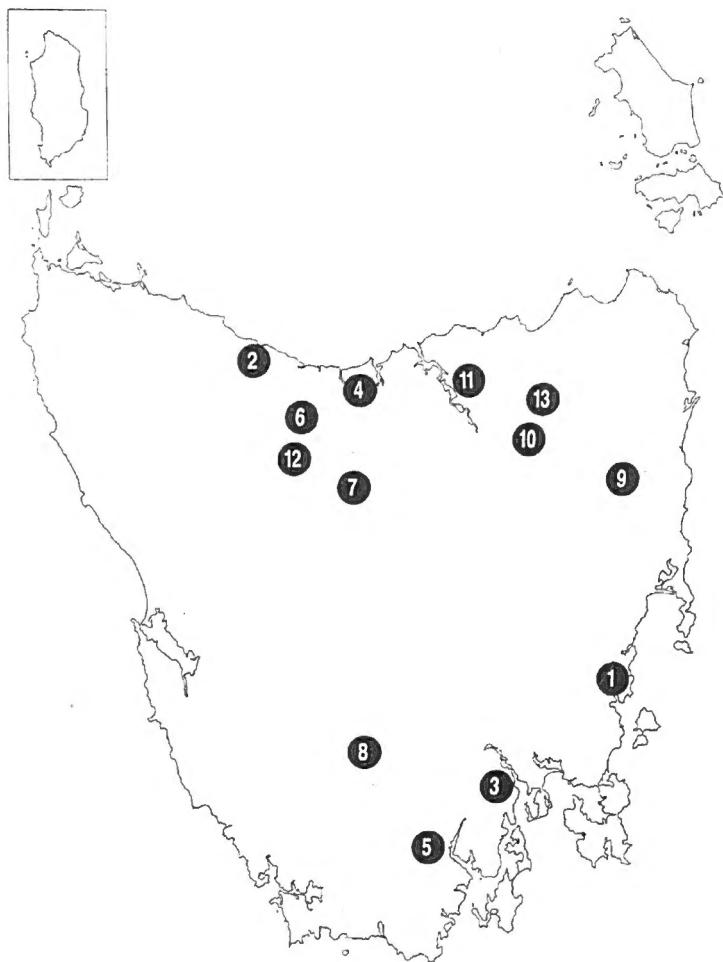


Fig. 1. Localities sampled for *Uromycladium* galls on *Acacia dealbata* in Tasmania. 1 = Triabunna; 2 = Burnie; 3 = Blackmans Bay; 4 = Wurra Wurra; 5 = Arve; 6 = Swamp Road; 7 = Lorinna; 8 = Westfield; 9 = Fingal Flats; 10 = Camden; 11 = Batman Bridge; 12 = Smiths Plains; 13 = Lisle.

Each gall was measured using vernier scale calipers for largest and smallest diameter of each gall and gall volume was calculated. Each gall was placed in an age category of young (<3-4 months) or old (>4 months), based on coloration, development and emergence exits. Young galls were all light brown in color, firm in texture, and had no emergence exits. Old galls were dark brown, hard in texture with some emergence exits (Fig. 2b). Division into age classes was done to determine when they were utilised by the immature stages of the Lepidoptera species.

In the laboratory individual galls were placed into clear plastic containers with perforated lids to prevent condensation. All galls were held at 18°C with light regime of 12h light/12 h dark, for four months. Emerging insects were removed weekly and stored either in 70% ethanol or frozen before being mounted. Retention of the galls at a constant temperature may have influenced the time of emergence of some individuals. However, collecting at different times of the year enabled emergence patterns to be assigned.

Results

Table 1 lists the Orders and species of insects inhabiting *U. tepperianum* galls on *A. dealbata* collected from thirteen sites in Tasmania. The following genera and species are not listed in Semmens *et al.* (1992). Lepidoptera: *Holocola triangulana* Meyrick (Tortricidae), *Polysoma eumetalla* (Meyrick) (Gracillariidae); Coleoptera: *Cryptarcha australis* Reitter, *Cryptarcha laevigata* Reitter, *Soronia superba* Reitter (all Nitidulidae), *Phalacrus uniformis* (Blackburn) (Phalacridae), *Araecerus palmaris* (Pascoe) (Anthribidae); Hymenoptera: *Bassas* sp. (Braconidae), *Glabridorsum stokesii* (Cameron) (Ichneumonidae). Lepidoptera nomenclature follows Nielsen *et al.* (1996).

Lepidoptera

Lawrence and Milner (1984) noted that galls caused by fungal infections are composed of relatively normal plant tissue and the lepidopterous larvae feeding on that tissue should therefore be regarded as phytophagous or saprophagous rather than true fungus feeders. New (1982) reared seven species of moths from *Uromycladium tepperianum* on *A. decurrens* growing in Melbourne. All of these species were reared in this study from Tasmanian galls except *Stathmopoda callichrysa* Lower (Oecophoridae), which is not recorded from Tasmania, and the unidentified Pyralidae.

The larvae of both *Gauna aegusalis* (Walker) (Pyralidae) and *Holocola triangulana* have been recorded burrowing in *Uromycladium* galls growing on wattles in SE Australia (Common 1990). Rawlins (1984) stated that the larvae of several species of *Stathmopoda* Herrich-Schäffer feed in rust galls on *Acacia* spp. and Common (1990) recorded both species found in this study (*S. cephalaea* Meyrick and *S. chalcotypa* Meyrick) from rust galls in southern Australia.

Table 1. Insect species emerging from *Uromycladium* galls at all sites sampled in Tasmania, with an indication of site/species similarity. Sites: 1 = Blackmans Bay; 2 = Triabunna; 3 = Burnie.

Emergent species	Main site 1	Main site 2	Main site 3
LEPIDOPTERA			
<i>Erechthias ancistrosema</i> Turner			x
<i>Erechthias mystacinella</i> (Walker)	x	x	x
<i>Opogona comptella</i> (Walker)			
<i>Polysoma eumetalla</i> (Meyrick)	x	x	x
<i>Stathmopoda cephalaea</i> Meyrick	x	x	x
<i>Stathmopoda chalcotypa</i> Meyrick			
<i>Macrobathra</i> Meyrick sp.	x		
<i>Holocola triangulana</i> Meyrick	x	x	x
<i>Gauna aegusalis</i> (Walker)	x	x	x
COLEOPTERA			
<i>Cryptarcha australis</i> Reitter	x		x
<i>Cryptarcha laevigata</i> Reitter	x	x	
<i>Soronia superba</i> Reitter	x	x	x
<i>Carpophilus aterrimus</i> Macleay		x	
<i>Carpophilus hemipterus</i> (L.)		x	
<i>Egolia variegata</i> Erichson			x
<i>Titaena tasmanica</i> Champion	x		x
<i>Blackburniella hilaris</i> (Westwood)		x	
<i>Araecerus palmaris</i> (Pascoe)	x		x
<i>Phalacrus uniformis</i> (Blackburn)	x	x	x
<i>Melanterius costipennis</i> Lea		x	
Curculionidae 7 spp.	x		x
Coccinellidae sp. A	x		
Coccinellidae sp. B	x	x	
Coccinellidae sp. C	x		
DIPTERA			
<i>Helina</i> R.-D. sp.			
HYMENOPTERA			
<i>Bracon</i> sp.	x	x	x
<i>Dolichogenidea</i> sp.	x	x	x
<i>Bassas</i> sp.	x		x
<i>Gladridorsum stokesii</i> (Cameron)	x		
<i>Campoplex</i> sp.	x	x	
<i>Isdromas</i> sp. 1	x	x	
<i>Isdromas</i> sp. 2	x		
Similarity coefficient (%)	100	65	72

Table 1 (continued). Sites: 4 = Wurra Wurra; 5 = Arve; 6 = Swamp Road; 7 = Lorinna; 8 = Westfield; 9 = Fingal Flats; 10 = Camden; 11 = Batman Bridge; 12 = Smiths Plains; 13 = Lisle.

Emergent species	4	5	6	7	8	9	10	11	12	13
LEPIDOPTERA										
<i>Erechthias ancistrosema</i>										
<i>Erechthias mystacinella</i>	x		x			x		x		x
<i>Opogona comptella</i>										x
<i>Polysoma eumetalla</i>	x	x	x		x		x		x	x
<i>Stathmopoda cephalaea</i>		x	x	x	x	x	x	x	x	x
<i>Stathmopoda chalcotypa</i>		x								x
<i>Macrobathra</i> sp.										
<i>Holocola triangulana</i>	x	x		x		x	x		x	x
<i>Gauna aegusalis</i>	x									
COLEOPTERA										
<i>Cryptarcha australis</i>		x	x					x		
<i>Cryptarcha laevigata</i>				x				x	x	
<i>Soronia superba</i>								x	x	
<i>Carpophilus aterrimus</i>		x								
<i>Carpophilus hemipterus</i>									x	
<i>Egolia variegata</i>										
<i>Titaena tasmanica</i>										
<i>Blackburniella hilari</i>						x				
<i>Araecerus palmaris</i>										
<i>Phalacrus uniformis</i>										
<i>Melanterius costipennis</i>								x		
Curculionidae 7 spp.										
Coccinellidae sp. A										
Coccinellidae sp. B										
Coccinellidae sp. C										
DIPTERA										
<i>Helina</i> sp.										x
HYMENOPTERA										
<i>Bracon</i> sp.		x	x							x
<i>Dolichogenidea</i> sp.	x	x				x			x	x
<i>Bassas</i> sp.	x	x				x			x	x
<i>Gladridorsum stokesii</i>										
<i>Campoplex</i> sp.		x								
<i>Isdromas</i> sp. 1		x								
<i>Isdromas</i> sp. 2										
Similarity coefficient (%)	47	57	29	23	23	47	23	40	45	53

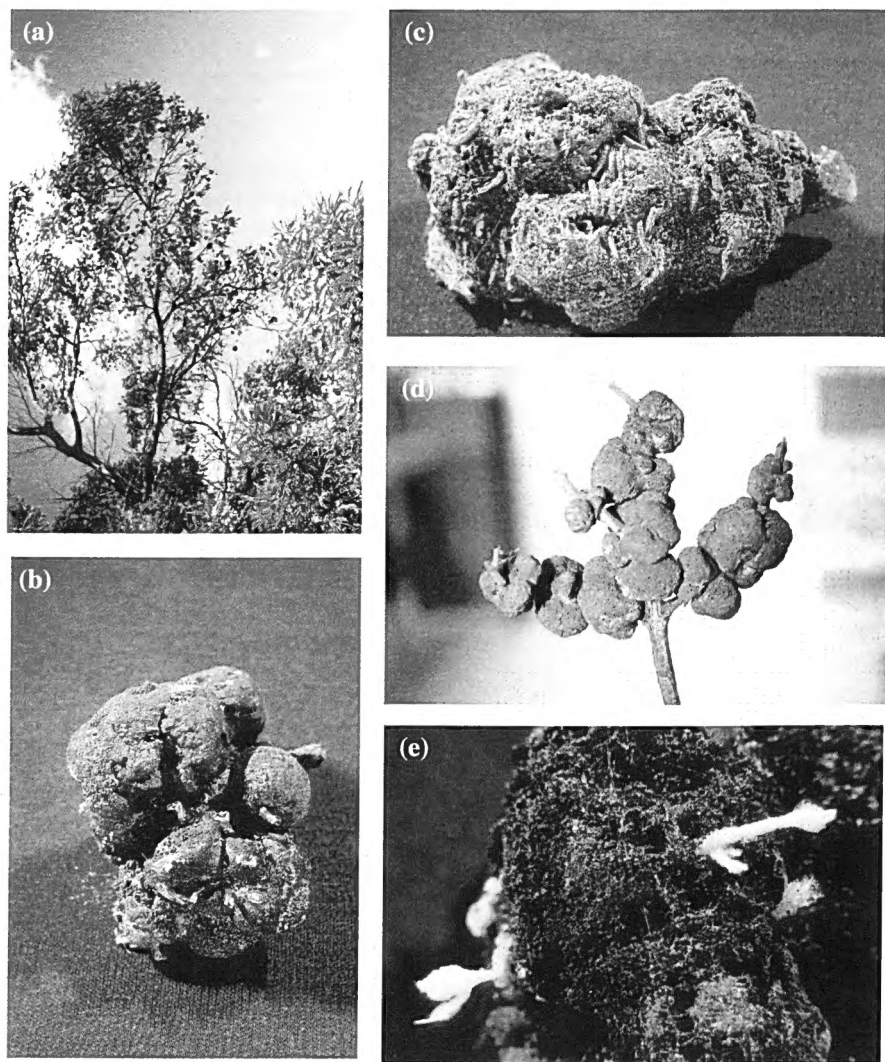


Fig. 2. *Uromycladium tepperianum* galls on *Acacia dealbata* in Tasmania. (a) decline of mature *A. dealbata* tree due to heavy infestation of galls; (b) succession of galls, young (light brown) to old (dark brown); (c) old gall with pupal emergence of *Erechthias mystacinella*; (d) typical stem-galling form of *U. tepperianum*; (e) stroma of the fungus *Paecilomyces* sp. emerging from lepidopterous hosts within the gall.

The metallic gracillariid moth *Polysoma eumetalla* (Meyrick) was common at most sites, the larvae emerging from the galls to pupate under white protective cocoons in the crevices between lobes of the galls. *Opogona comptella* (Walker) (Tineidae) and an undetermined species of *Macrobathra* Meyrick (Cosmopterygidae) were collected at a single site each.

Of interest is *Erechthias ancistrosema* Turner (Tineidae), previously known only from the holotype from Burnie and with its biology unknown. Twelve specimens were reared from galls collected at Burnie, emerging between November and February. The moth only emerged from old galls from which other species had emerged previously. One categorization of a species being rare is if it fills the criteria of occurring in low numbers compared to emergence of other members of the habitat guild and in a limited distribution within that habitat. In this case 12 specimens of *E. ancistrosema* were reared among a total of 241 moths at the Burnie site (comprising <5% of the moth population) and collected at only one site out of thirteen. All other moth species within the guild emerged from galls collected from at least three sites. Clearly *E. ancistrosema* is spatially concordant in the sense of Gaston (1994) and merits conservation measures for preservation of the species. Loss of habitat due to tree removal places this species under threat.

In some older galls collected at several sites and containing lepidopterous larvae, white stroma of the pathogenic necrotrophic hyphomycetes fungus *Paecilomyces* sp. developed, protruding from the galls to a height of three centimeters. Several galls containing the fungus were dissected and the hosts identified as lepidopterous larvae. This entomophagous fungus has been recorded attacking dipterous larvae (Stratiomyidae) in Australia. However in this study the fungus was not recorded from the Lisle site galls from which dipterous (Muscidae) emergence occurred (Fig. 2e).

Emergence of the three most common moths, *Erechthias mystacinella* (Walker) (Tineidae), *H. triangulana* and *S. cephalaea*, occurred in all months of the year, peaking in spring and summer, indicating these species may have several generations a year utilising the gall resource. The other species were summer/autumn emergents, indicating a univoltine life cycle. The rare *E. ancistrosema* emerged from October to February (Table 2).

All moths co-occurred with other moth species. At the three main collection sites, moths did not occupy 22.2% of galls collected while 42.4-53.9% of galls yielded one species of moth. A maximum of four moths per gall was recorded from one gall only. Table 3 lists the number of moth species per gall emerging from galls collected at these sites, where *E. mystacinella* was the most common moth to emerge followed by *S. cephalaea*. The degree of dominance for these two species is shown in Table 4.

The three main collection sites showed marked differences in the numbers of moths emerging throughout the year (Table 5). The Blackmans Bay site had a

monthly emergence mean of 11.05 moths (1.81 species per gall), compared to Triabunna 5.68 (1.18 species per gall) and Burnie 2.4 (0.8 species per gall). There were no winter collections made at the Burnie site. All sites had the same complex of common moth species.

Table 2. Number of individuals of each moth species reared from *U. tepperianum* galls each month in Tasmania.

Moth species	Jan	Feb	Mar	Apr	May	June	
<i>Erechthias ancistrosema</i>		2					
<i>Erechthias mystacinella</i>	24	58	120	59	251	146	
<i>Opogona comptella</i>							
<i>Polysoma eumetalla</i>	5		20		18		
<i>Stathmopoda cephalaea</i>	85	174	173	23	101	16	
<i>Stathmopoda chalcotypa</i>							
<i>Macrobathra</i> sp.							
<i>Holocola triangulana</i>	35	49	87	3	40	37	
<i>Gauna aegusalis</i>			3	2	4		
TOTAL	149	283	403	87	414	199	

Moth species	July	Aug	Sept	Oct	Nov	Dec	Total
<i>Erechthias ancistrosema</i>				1	8	1	12
<i>Erechthias mystacinella</i>	441	363	233	238	364	190	2487
<i>Opogona comptella</i>		1			4		5
<i>Polysoma eumetalla</i>						1	44
<i>Stathmopoda cephalaea</i>	29	31	18	168	325	142	1285
<i>Stathmopoda chalcotypa</i>					2	1	3
<i>Macrobathra</i> sp.					3		3
<i>Holocola triangulana</i>	31	36	37	97	52	14	518
<i>Gauna aegusalis</i>							9
TOTAL	501	431	288	504	758	349	4366

Table 3. Number of moth species co-inhabiting *Uromycladium* galls at three sites in Tasmania.

Site	0 spp.	1 sp.	2 spp.	3 spp.	4 spp.	5 spp.
Triabunna	35	72	37	11	0	0
Burnie	40	62	12	1	0	0
Blackmans Bay	23	66	100	56	1	0
% of total	22.2	42.4	24.8	10.3	0.3	0

Table 4. Degree of dominance of the two most abundant moth species reared from *U. tepperianum* galls at three sites in Tasmania. Species A = *Erechthias mystacinella*; Species B = *Stathmopoda cephalaea*. Degree of dominance, $d = (N/NT) \times 100$.

Site	Species	d	Species	d
Triabunna	A	48.44	B	44.46
Burnie	A	60.08	B	33.33
Blackmans Bay	A	66.06	B	19.28

Table 5. Total number and number of species of moths reared from *Uromycladium* galls at different times of the year.

TRIABUNNA

Collection date	No. of galls	Total no. of moths	No. of moth species	Individuals/gall (Mean \pm SD)	Species/gall (Mean \pm SD)
7.x.1997	40	309	3	7.9 \pm 6.4	1.4 \pm 0.6
13.xi.1997	41	225	3	5.5 \pm 4.8	1.0 \pm 0.6
23.xii.1997	11	79	4	7.3 \pm 4.9	1.6 \pm 0.8
18.ii.1998	31	206	3	6.7 \pm 6.9	1.4 \pm 1.1
16.iv.1998	33	206	3	1.0 \pm 1.7	0.5 \pm 0.8

BURNIE

Collection date	No. of galls	Total no. of moths	No. of moth species	Individuals/gall (Mean \pm SD)	Species/gall (Mean \pm SD)
24.x.1997	54	72	4	1.4 \pm 1.9	0.7 \pm 0.6
31.x.1997	45	117	4	2.6 \pm 3.3	0.8 \pm 1.1
23.i.1998	16	52	4	3.3 \pm 5.2	0.9 \pm 1.0

BLACKMANS BAY

Collection date	No. of galls	Total no. of moths	No. of moth species	Individuals/gall (Mean \pm SD)	Species/gall (Mean \pm SD)
22.ix.1997	100	742	4	7.5 \pm 11.5	1.7 \pm 1.0
22.xii.1997	22	198	3	9.0 \pm 7.0	2.1 \pm 0.9
18.i.1998	19	143	4	7.6 \pm 6.7	1.5 \pm 0.6
25.ii.1998	29	226	4	8.1 \pm 11.9	1.7 \pm 1.0
21.v.1998	28	652	3	23.4 \pm 15.5	1.9 \pm 0.8
19.vii.1998	48	714	4	10.7 \pm 11.9	2.0 \pm 0.8

Collections of old and green galls were made to determine preferences by different moth species. *E. mystacinella* and *E. ancistrosema* emerged mainly from old galls (Fig.2c), while *S. cephalaea* emerged mainly from green galls. Several of the moth species are capable of colonising and completing development in green galls. Only one species, *E. mystacinella*, demonstrated a statistically significant relationship with a gall age class as shown in Table 6 (ANOVA, $F_{2,328}=5.70$, $P<0.026$). The utilisation of the gall habitat is shown in Table 7. Overall, the mean gall volume used per moth was 95.26 mm^3 and the mean total gall volume for the three main sites was 289.7 mm^3 . Lepidoptera occupied 95% of all green galls at the Blackmans Bay site.

Table 6. Moth emergence from young and old galls.

Moth species	Number of emerging moths	
	Old galls	Young galls
<i>Erechthias ancistrosema</i>	12	0
<i>Erechthias mystacinella</i>	2015	313
<i>Stathmopoda cephalaea</i>	368	555
<i>Holocola triangulana</i>	223	177
<i>Gauna aegusalis</i>	2	2

Table 7. Gall volume (mm^3) utilised by moth species at three sites in Tasmania.

Site	Gall volume/moth (Mean \pm SD)	Gall volume (Mean \pm SD)	Number of galls
Triabunna	66.3 ± 89.3	274.1 ± 183.6	157
Burnie	177.4 ± 172.1	362.7 ± 314.9	115
Blackmans Bay	42.1 ± 70.4	232.4 ± 218.6	246

Coleoptera

Both adult and larval stages of the phalacrid beetle *Phalacrus uniformis* feed on the surface spores covering young *Uromycladium* galls (T. Weir, pers. comm.). Larvae live in the narrow separations between the lobes of the galls while adults hibernate in old galls (Steiner 1984). This species was the most common coleopteran species (74% of all beetles collected) and present at all sites where young galls were collected.

The anthribid *Araecerus palmaris* is known to feed on and lay its eggs in *Uromycladium* rust galls. Large numbers of fungal spores are present in the hindgut of dissected adults (Zimmermann 1994). New (1984) stated that *A. palmaris* (as *Doticus pestilens* Oliff) was the most abundant beetle reared from *Uromycladium* galls in Victoria, which was not the case in this study in Tasmania. The first note on the association of *A. palmaris* with

Uromycladium galls was by Froggatt (1907). Gourlay (1929) studied the life history of this beetle in New Zealand and found both adults and larvae present in *Uromycladium* galls during winter, with the emergence of adults in November. Holloway (1982) suggested that there are two emergence periods, from March-April and Sept.-Nov. in New Zealand. In Tasmania only one emergence peak was observed, in early summer, but continued emergence between June to March may be due to sheltering adults utilising old galls. The beetle emerged from the two sites of Blackmans Bay and Burnie. At the Blackmans Bay site 15.4% of all beetles emerging from galls, which had already had some emergence by other insect species, were *A. palmaris*. The sex ratio was males : females 0.88:1 (n=95). This is the first published record of this species in Tasmania. A related species, *A. lindensis* Blackburn, was collected by Charles Darwin in Tasmania.

The weevil *Melanterius costipennis* Lea (Cryptorhynchinae) was reared in large numbers from galls collected at the Batman Bridge and Triabunna sites. Larvae were present in young galls, their tunneling hollowing out the galls. Emergence of the adults occurred during December-February. Zimmerman (1994) noted that this species has been recorded on several species of *Acacia* in Tasmania, Victoria and New South Wales and specifically recorded emerging from *Uromycladium* galls in Canberra, ACT. Members of the genus are common weevil predators of *Acacia* seed. The other curculionid species recorded all appear to be transient migrants (T. Weir, pers. comm.).

Cryptarcha laevigata, *C. australis*, *Carpophilus hemipterus* (L.) and *C. aterrimus* Macleay (Nitidulidae) are all considered to be sap rather than spore feeders. *Titaena tasmanica* Champion (Tenebrionidae) probably feeds on lichens or algae (T. Weir, pers. comm.) but larvae may graze on the surface of the galls at night (J. Lawrence, pers. comm.). It appears that these coleopterous species, along with the predaceous coccinellids and trogossid species, are all utilising the old-tunnelled galls as refuges or as habitats for prey species. Species of *Soronia* (Nitidulidae) have been reared from polyporaceous fungi in NSW (Webb and Simpson 1991). *C. australis* was recorded from *Uromycladium* galls by Tillyard (1926), who commented that the species utilised many other refuges as adults. *Egolia variegata* Erichson (Trogossitidae) was collected only from the Burnie site but is recorded as a common predator throughout much of the forested areas of Tasmania (Tasmanian Forest Insect Collection records) and, together with *Blackburniella hilaris* (Westwood) (Cleridae) and the coccinellids, may be regarded as incidentals on the galls.

Diptera

An undetermined species of *Helina* Robineau-Desvoidy (Muscidae) was collected only from the Lisle site in one collecting period. A total of 116 adults emerged over a period of 10 days in September, from a total of 15 old

galls. The only lepidopterous species to emerge from the Lisle galls in this collection period was *Stathmopoda cephalaea*. The species is not parasitic or predatory but larvae may feed on dead and decomposing lepidopterous larvae within the galls (D. Colless, pers. comm.).

Hymenoptera

All of the hymenopterous species are parasitoids of larvae feeding within the galls. Both *Campoplex* sp. and *Glabridorsum stokesii* (Ichneumonidae) are recorded as generalist parasitoids of lepidopterous species. The two *Isdromas* species (Ichneumonidae) appear restricted to a tineid host (*Erechtheus mystacinella*) but may also be a hyperparasitoid of *Dolichogenidea* sp. (Braconidae) (S. Schmidt, pers. comm.). *Dolichogenidea* sp. was reared from some galls which only had the gracillariid moth *Polysoma eumetalla* emerge. *G. stokesii* was reared only from galls containing *Stathmopoda cephalaea* (Table 8). None of the galls retained individually for parasite host studies had a single species of beetle emerge without any moth species, so it was not possible to determine if any of the parasitoids utilised beetle larvae as hosts.

Parasitism levels are difficult to assess in a complex of insect species inhabiting galls. At the Blackmans Bay site the total number of lepidopterous pupal cases was counted from 246 galls and a count made of hymenopterous adults emerging from the same galls. The total number of adult insects that emerged was 3,167 (Lepidoptera 2,675, parasitoids 492). The mean number of parasitoids per gall was 2.11. This indicates a parasitism level of 15%, admitting the fact that lepidopteran larval mortality from other causes was not known. This result indicates higher levels of parasitism than that recorded by McGeoch and Chown (1997) in a similar complex of insects inhabiting *Ravenelia* galls on *Acacia* in South Africa. In that study only 0.6% of lepidopterous larvae were parasitised.

Table 8. Emergence of Lepidoptera and Hymenoptera from the same gall.

HYMENOPTERA	<i>Bracon</i> sp.	<i>Dolicho-</i> <i>genidea</i> sp.	<i>Bassas</i> sp.	<i>Comp-</i> <i>oplex</i> sp.	<i>Gladri-</i> <i>dorsum</i> <i>stokesii</i>	<i>Isdro-</i> <i>mas</i> sp. 1	<i>Isdro-</i> <i>mas</i> sp. 2
LEPIDOPTERA							
<i>Erechthias</i>	x	x	x			x	x
<i>mystacinella</i>							
<i>Polysoma eumetalla</i>		x					
<i>Stathmopoda</i>	x	x	x		x		
<i>cephalaea</i>							
<i>Macrobothra</i> sp.		x	x	x			
<i>Holocola</i>	x	x	x				
<i>triangulana</i>							
<i>Gauna aegusalis</i>				x			

Impact of *Uromycladium* galls on the host plant

Uromycladium (Basidiomycota: Uredinales) is a genus native to Australia but closely related to other ravenelioid rusts distributed throughout the southern hemisphere (Orchard 1996). *U. tepperianum* forms round galls on terminal branch stems, phyllodes and the tips of flowering shoots (Fig. 2d). When formed on flowering shoots, the developing galls resemble bunches of grapes and the galls remain as single entities without developing new galls on older ones, as happens on stem inhabiting galls. A smaller guild of insects than those inhabiting stem rusts, partly due to the smaller size and longevity of the gall on the tree, occupy these galls.

New galls first appear in June/July and develop through the summer months, changing from the light brown color to a darker spore-free surface when fully developed in late autumn. During early winter the galls become hard and brittle as they die, a process frequently hastened by insect activity. The gall mass increases in size as new galls develop on older ones resulting in large irregularly shaped globular gall masses up to 100 cm³ in volume. The galls cause death of branches and heavy infestations over several years can cause the death of mature trees (Fig 2a).

Another species of *Uromycladium*, *U. notabile*, was occasionally found developing on the phyllodes and terminal shoots of *A. dealbata*, causing growth distortion. The galls formed by this species are not globose or large and support fewer insects than *U. tepperianum*. The lepidopteran species *Polysoma eumetalla* (27 adults from 4 galls), *Erechthias mystacinella* (7 adults from 3 galls) and *Stathmopoda chalcotypa* (7 adults from 3 galls) were reared from *U. notabile* galls on *A. dealbata*.

Burges (1934) recognized seven species of *Uromycladium* in Australia, restricted to *Acacia* species except *U. tepperianum*, which also occurs on *Albizzia*. *U. tepperianum* has now been recorded on 118 known hosts in the genera *Acacia* and *Albizzia* (Gathe 1971). In this study galls of both *U. tepperianum* and *U. notabile* were found on the Tasmanian endemic *Acacia riceana*, constituting new host tree records for these fungi.

Discussion

There is little evidence to suggest that any of the moth species inhabiting *Uromycladium* galls are totally dependent on that type of gall. Other work on insect-induced galls in Tasmania demonstrates that all but one (*Erechthias ancistrosema*) also utilise other gall forms on *Acacia* species. (Bashford, in prep.). The widespread distribution of *Uromycladium*-affected *Acacia* spp. makes them an important habitat resource for insects non-dependent on induced gall formation. The importance of stable guild populations may be of importance to timber production in the future if exotic gall forming insects are introduced. Having widely distributed generalist parasitoids may reduce the impact of such exotics. This further enhances the need for reserves of

succession forest that will support potential control agents within production forest areas.

At least one interesting question has emerged from this study. How important are the moths emerging as adults from young galls in the dispersal of spores? *Uromycladium tepperianum* spores are prolific on the outer surface of young galls and are easily wind dispersed. However the emergence of large numbers of moths from young galls would result in the direct dispersal of spores to other *Acacia* trees. There may therefore be a mutualistic relationship between some moths and the fungus. The moth benefits in the immature stage by having protection and a food resource while the fungus obtains direct spore dispersal.

The finding of the rare endemic species *E. ancistrosema* is important for several reasons. This study has demonstrated that the species is associated with galls. The fact that the adults only emerged from old galls indicates a long larval development period in young galls. The collection of specimens from near the holotype locality suggests that the species continues to have a very restricted distribution. Since the completion of this study, all gall-infested trees at the Burnie site have been removed due to their declining health. This practice increases the vulnerability of this species but, like other tineids, it may inhabit other gall types in the area.

Site similarity as shown in Table 1 reflects the sampling effort. The three main sites, which were sampled throughout the 14 month period, all contain a high proportion of the total number of species reared. More frequent sampling at the other sites would most likely have increased the number of species at those sites. The value of opportunistic sampling is reflected in emergence from the Lisle site galls of two lepidopterous species, both new records for Tasmania.

This study parallels much of the work reported by New (1984) and McGeoch and Chown (1997) on Lepidoptera inhabiting rust galls. The current study has taken a landscape approach to gall utilisation and an attempt has been made to determine the complete insect fauna utilizing these galls in Tasmania. The information provided in these and other ongoing studies provides the basis for future investigations of 'island' communities, examining heterogeneity of species composition, biotic interactions, community stability on a regional scale and the dynamics of rare species.

Acknowledgements

Mr Tim Wardlaw (Forestry Tasmania) identified the *Uromycladium* and *Paecilomyces* fungi. Specialists at the Australian National Insect Collection (CSIRO, Canberra) kindly identified some of the Lepidoptera, Coleoptera and Hymenoptera morphospecies. Dr Andrew Austin (Waite Institute, South Australia) examined the braconids.

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A NOTE ON THE BIOLOGY OF *TERMITORIOXA TERMITOXENA* (BEZZI) (DIPTERA: TEPHRITIDAE)

D.L. HANCOCK

PO Box 2464, Cairns, Qld 4870

Abstract

Termitorioxo termitoxena (Bezzi) breeds beneath bark of standing trees. An earlier association with termite galleries is presumed to be incidental.

Discussion

Termitorioxo termitoxena (Bezzi) is a tropical Australian fruit fly belonging to the tribe Acanthonevrini, most members of which breed in decaying fruit, fallen logs, beneath bark or in native figs (Permkam and Hancock 1995). The type series of *T. termitoxena* was bred from galleries of *Mastotermes darwiniensis* Hill in tree trunks at Darwin (Bezzi 1919).

In the Northern Territory, *T. termitoxena* has been bred from larvae collected in oozing resin beneath the bark of *Terminalia* sp. (Combretaceae) damaged by a cerambycid beetle [1 ♀ examined, Darwin, 31.i.1976, P. I. Whelan]. Permkam and Hancock (1995) also recorded a female ovipositing in the trunk of *Delonix regia* (poinciana: Fabaceae) in Darwin. It is likely that the association of the type series with termites was incidental and that this species normally breeds beneath decaying tree bark, as in the related *Lumirioxo araucariae* (Tryon), which breeds in a wet rot beneath the bark of *Araucaria cunninghamii* (Araucariaceae) (Brimblecombe 1945). Several other genera of Australian Acanthonevrini and Phytalmiini breed or are believed to breed beneath bark. *Austronevra* Permkam & Hancock, *Dacopsis* Hering and *Phytalmia* Gerstaecker breed in fallen logs of *Dysoxylum gaudichaudianum* (Meliaceae) (Dodson and Daniels 1988). *Austrorioxo* Permkam & Hancock and *Copiolepis* Enderlein may also be log breeders. *Acanthonevroides* Permkam & Hancock, *Aridonevra* Permkam & Hancock and *Taeniorioxo* Permkam & Hancock are closely related to *Termitorioxo* Hendel and presumably also breed beneath the bark of standing trees.

Acknowledgement

I thank Glenn Bellis (AQIS, Darwin) for the loan of material.

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A NEW SPECIES OF *SIPHANTA* STÅL (HEMIPTERA: FLATIDAE) FROM WESTERN AUSTRALIA AND NOTES ON OTHER SPECIES OF THE GENUS

MURRAY J. FLETCHER

Agricultural Scientific Collections Unit, Orange Agricultural Institute, Forest Road,
Orange, NSW 2800

Abstract

Siphanta striata sp. nov. is described and illustrated. The species is close to *Siphanta luteolineata* Fletcher. This brings the number of species in the genus to 41, of which 37 are restricted to Australia. Six colour forms of *Siphanta patruelis* (Stål) are figured, including a previously unknown form from Western Australia here given the infrasubspecific name "form *drysdalensis*". The presence of *Siphanta acuta* (Walker) in the United States is reported and its likely presence on the island of New Guinea discussed.

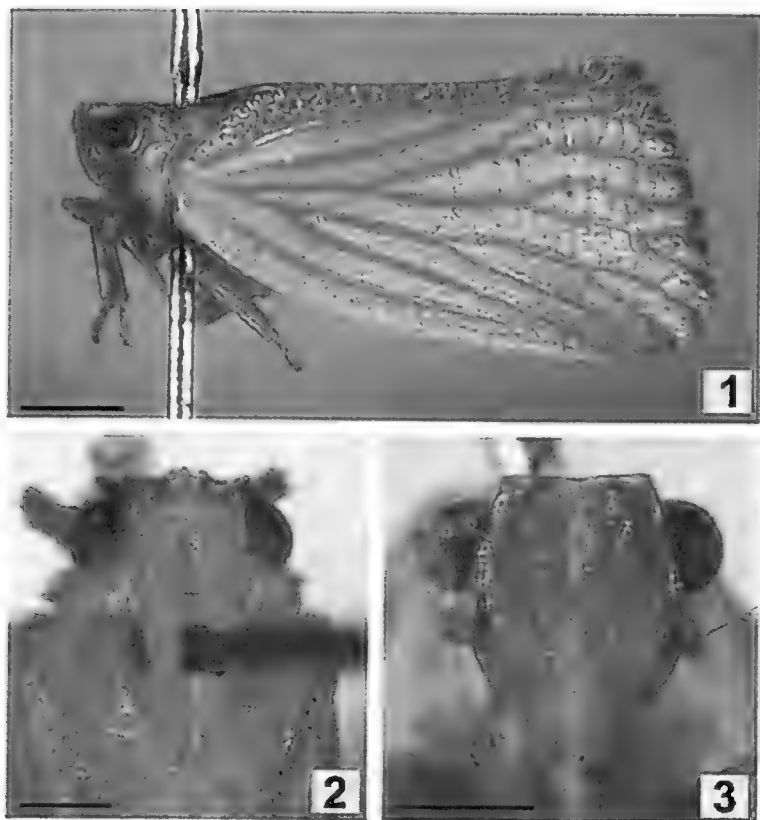
Introduction

The genus *Siphanta* Stål was revised by Fletcher (1985) who recognised 40 species, of which all but four are restricted to Australia and one, *S. expatria* Fletcher, is only recorded from New Guinea (Irian Jaya and possibly Papua New Guinea). The other three species extend from Australia into neighbouring regions: *S. patruelis* (Stål) from Australia to New Guinea, Indonesia and the Philippines, *S. lucindae* Kirkaldy in Australia and New Guinea and *S. acuta* (Walker) from Australia to New Zealand and Hawaii and is here recorded from California, USA. Medler's (2000) record of *S. acuta* from New Guinea is discussed below. This paper adds a further species, *S. striata* sp. nov. from Western Australia.

Materials and methods

The colour photographs included in this paper were taken with an Agfa ePhoto 1680 digital camera through a Zeiss Stemi SV8 stereomicroscope fitted with a phototube. The male genitalia of the holotype of *S. striata* were removed and macerated in 10% KOH before being photographed using the same camera and microscope. Figure 4 was produced using Photoshop 5.0 by adding a layer to the digital image and tracing over the pygofer and subgenital plates in the photograph. The background image was then deleted leaving the line drawing. The aedeagus illustration was produced by initially printing a copy of the genitalia photograph and tracing over the aedeagus with pencil to highlight the relevant parts. This image was then scanned using an HP Scanjet ADF and the image traced in Photoshop using the same technique as used for the external genitalia.

Repositories of examined material are: ANIC - Australian National Insect Collection, Canberra; ASCU - Agricultural Scientific Collections Unit, NSW Agriculture, Orange; MAMU - Macleay Museum, University of Sydney.



Figs 1-3. *Siphanta striata* sp. nov. (1) habitus; (2) dorsum; (3) frontal view of head. Scale bars: (1) 1 mm; (2-3) 0.5 mm.

***Siphanta striata* sp. nov.**

(Figs 1-5)

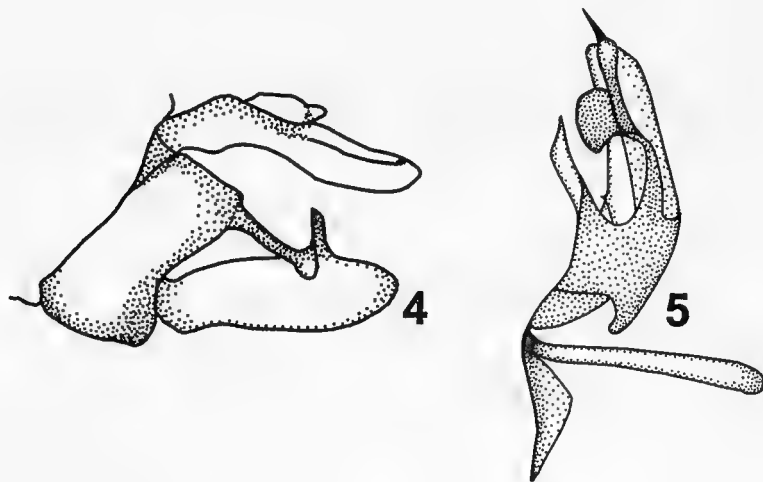
Types. *Holotype* ♂, WESTERN AUSTRALIA: Drysdale River, 14.39S 126.57E, 18-21.viii.1975, I.F.B. Common and M.S. Upton (ANIC). *Paratype* ♀, same data as holotype (ANIC).

Description. Coloration: Frons partly testaceous, heavily mottled with dark red, more heavily towards apical margin and lateral margins which are finely rimmed with black, becoming sordid brown ventrally. Vertex orange basally

merging to red towards anterior and lateral margins with line of testaceous round spots around margins. Pronotum and mesonotum orange with median longitudinal stripe and lateral carinae broadly and percurrently green. Tegmen with longitudinal veins broadly orange-red, cells and costal margin pale testaceous, apical cells becoming dark red towards apical margin and granules of corium and clavus finely tipped with black.

Morphology: Frons (Fig. 3) about as wide as long to frontoclypeal suture. Lateral margins strongly carinate, almost foliaceous, apical margin percurrently carinate and medial longitudinal carina well developed throughout. Vertex (Fig. 2) wider than long (2.75:1), concave between carinate margins, slightly corrugated laterally. Anterior margin broadly and obtusely angulate. Hind margin concave. Pronotum (Fig. 2) anterior margin broadly convex, produced medially to align with hind margin of vertex. Lateral carinae well defined. Hind margin roundly and broadly V-shaped. Tegmen (Fig. 1) without, or with very obscure, cross venation in basal two-thirds, including clavus. Sutural angle rounded, slightly more obtuse than right angle. Apical margin broadly rounded. Metatibial spine formula 1:6.

Male genitalia: Anal segment elongate, apically flattened and broad. Pygofer (Fig. 4) with process elongate, apically slightly curved dorsally and clubbed. Subgenital plates (Fig. 4) narrow, parallel-sided, apically acute with dorsal process apically truncate-pointed, perpendicular to plate margin and remote from apex of plate. Aedeagus as in Figure 5.



Figs 4-5. *Siphanta striata* sp. nov. (4) male terminalia, lateral view; (5) aedeagus, lateral view.

Comments. This species keys out as *Siphanta luteolineata* Fletcher in the key to species of *Siphanta* provided by Fletcher (1985) but can be easily distinguished from that species by the marked striping on the tegmen, the somewhat rugose vertex and the structure of the male genitalia, particularly the markedly pointed apical processes of the aedeagus. Both species share an absence of crossveins in the sutural cell, a concave vertex and bright striping on the head and pronotum. Full colour images of both species can be seen in Fletcher and Larivière (2001 + updates) at <http://www.agric.nsw.gov.au/Hort/ascu/fulgor/flat0.htm>.

Siphanta patruelis (Stål)

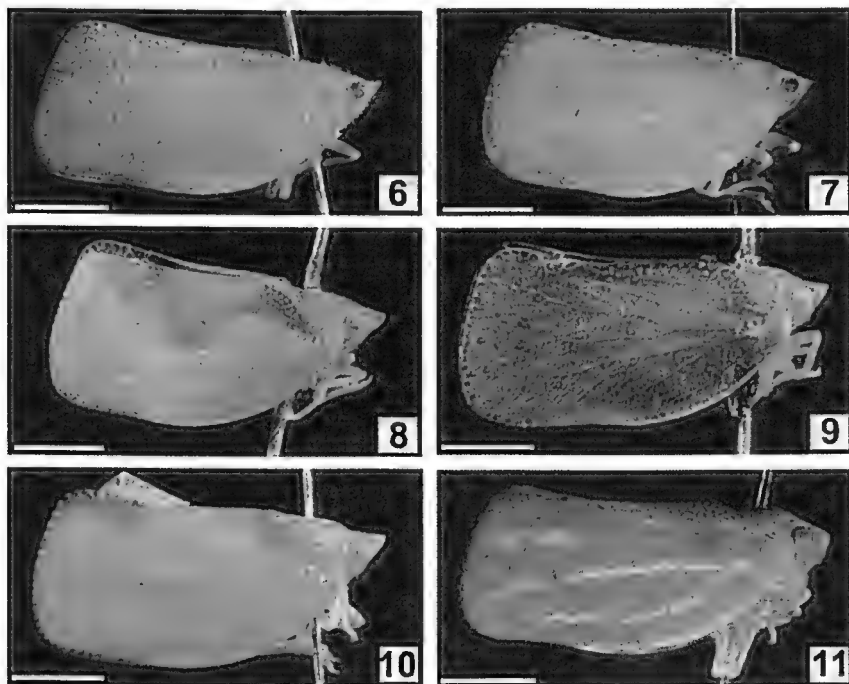
(Figs 6-11)

Material examined. WESTERN AUSTRALIA: 2 ♂♂, 1 ♀, Drysdale River, 14.39S 126.57E, 18-21.viii.1975, I.F.B. Common and M.S. Upton; 5 ♂♂, 1 ♀, Carson escarpment, 14.49S 126.49E, 9-15.viii.1975, I.F.B. Common and M.S. Upton (all in ANIC except 1 ♂ from each locality in ASCU).

Comments. *S. patruelis* is known to occur in several colour forms, most of which have been described as separate species which were synonymised by Fletcher (1985). The typical form (Fig. 6) has the tegmen of more or less uniform green or greenish-yellow colour throughout, sometimes with the margins finely marked with red. The tegminal granules are black-tipped and sometimes also surrounded by a narrow red rim. A form from Cairns, northern Qld, with a pale oblique longitudinal stripe through the tegmen (Fig. 7), was described by Kirkaldy (1906) as *S. toga* Kirkaldy. Distant (1910) described, as *Parasalurnis infumata* Distant, a form from Townsville, northern Qld, with extensive brown coloration on the posterior half of the tegmen (Fig. 8) and this brown coloration may completely cover the tegmen (Fig. 9). Lallemand (1935) described a form from the Northern Territory, with this brown coloration broken up into discrete brown patches (Fig. 10), as *S. toga* var. *maculata* Lallemand. The two series of specimens from Western Australia detailed above match *S. patruelis* in the shape of the tegmen, the presence of dark-tipped granules on the tegmen and the structure of the male genitalia, but differ from all the above forms in the presence of a series of pale longitudinal stripes in the longitudinal cells of the tegmen. The vertex is also slightly shorter than in the typical form. This new form, here called "form drysdalensis", is shown in Figure 11.

The names applied to these colour forms are currently infrasubspecific and hence have no validity, at this taxonomic level, under the terms of the Code (ICZN 1999, Art. 15.2). However, "toga" and "infumata" were originally published as species names (Kirkaldy 1906, Distant 1910) and "maculata", although originally published as a "form" (Lallemand 1935), was published prior to 1961 so is recognised by the Code as having subspecific rank at the time of publication (ICZN 1999, Art. 45.6.4). These three names are therefore recognised by the Code and would regain valid status from their original dates

of publication if they are ever restored to a taxonomic level, such as subspecies, which is recognised under the Code. Since the forms are not geographically isolated from the typical form, which occurs throughout the distribution of the species, it is unlikely that sufficient evidence will be found to justify recognition of these colour forms as subspecies.



Figs 6-11. *Siphanta patruelis*. (6) typical form; (7) "toga" form; (8) "infumata" form; (9) brown form of "infumata"; (10) "maculata" form; (11) "drysdalensis" form. Scale bars: 2 mm.

Siphanta acuta (Walker)

Comments. This species was recorded from all States of Australia and from New Zealand and Hawaii (Hawaii, Kauai, Molokai, Oahu, West Maui) by Fletcher (1985). It is also reported to be seen commonly in gardens in California, USA (E. E. Taylor, pers. comm.). Medler (2000) gives records of *S. acuta* from the island of New Guinea but he also lists *S. lucindae* erroneously as a synonym of that species. Since there is no indication of a proposed new synonymy, it appears that this is an editorial error. It therefore follows that the records from New Guinea provided by Medler (2000) may refer to *S. lucindae*, since his "previously published" locality records are those provided by Fletcher (1985) as the Papua New Guinea records of *S.*

lucindae. Consequently, Medler's (2000) new records from New Guinea may also be for *S. lucindae*. The presence of *S. acuta* in New Guinea thus remains unconfirmed, although the current wide distribution of the species indicates that its presence there is highly likely.

A specimen of *S. acuta* in MAMU is labelled 'Georgia', apparently in George Masters' handwriting, but without further details. It is uncertain whether this label is accurate and the record from Georgia (USA or Eastern Europe) remains unverified. The specimen is probably a male, based on size, but the abdomen is missing.

Acknowledgements

The author thanks Graham Crompton (ANIC) for the loan of specimens and permission to deposit reference specimens in ASCU and Margaret Humphrey (MAMU) for arranging access to the Macleay insect collection.

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THE EARLY IMMATURE STAGES OF *HYPOCHRYSOPS ELGNERI* BARNARDI WATERHOUSE AND *H. HIPPURIS NEBULOSIS* SANDS (LEPIDOPTERA: LYCAENIDAE)

P.R. SAMSON

Bureau of Sugar Experiment Stations, PMB 57, Mackay Mail Centre, Qld 4741

Abstract

Eggs and early instar larvae of *Hypochrysops elgneri barnardi* Waterhouse and *H. hippuris nebulosis* Sands from northern Queensland are described and illustrated. Eggs of each were laid singly on the food plants, those of *H. e. barnardi* mostly beneath leaves of the tree *Nauclea orientalis* (Rubiaceae) and those of *H. h. nebulosis* mostly on the rhizome of the fern *Pyrrosia lanceolata* (Polypodiaceae). Small larvae of *H. e. barnardi* ate leaves of *N. orientalis* whereas small larvae of *H. h. nebulosis* mainly ate the rhizome until the third instar, when they fed on the fern blades. Larvae of *H. e. barnardi* and *H. h. nebulosis* passed through 7 and 6 instars, respectively.

Introduction

Hypochrysops elgneri barnardi Waterhouse and *H. hippuris nebulosis* Sands are known in mainland Australia only from areas in or near rainforest within Cape York Peninsula, northern Queensland. The life histories of each have been recorded recently (Samson *et al.* 1997, Johnson and Valentine 2001). However, the eggs and first instars have not been described, other than a hatched egg of *H. e. barnardi* (Samson *et al.* 1997). Here I describe the early immature stages of both species from material collected near the Claudie River in August 2001.

Hypochrysops elgneri barnardi

Egg (Fig. 1). A flattened sphere, with coarse network of fine oblique ridges forming diamond-shaped cells with long spines at their intersection; dark greenish blue, spines white. Diameter 0.9 mm including spines.

First instar (Fig. 2). Prothorax (T1) with dark brown marginal hairs; meso- and metathorax (T2 and T3) and abdominal segments 1-7 (A1-A7) each with three pairs of long lateral hairs, the central pair brown on A3-A7 but otherwise colourless; anal segments A8-A10 with very long dark brown or colourless marginal hairs; each segment with one pair of colourless ventrolateral hairs; prothoracic plate dorsally with two pairs of long dark brown hairs; T2 with two pairs of long dark brown dorsal hairs, the two hairs on each side held together; T3-A6 each with two pairs of dorsal hairs, the outer pair short, dark brown on A1-A3 and A6 but otherwise colourless, the inner pair long dark brown though of decreasing length from T3 to A3 and held together vertically, much shorter than outer pair on A4-A6; two pairs of long brown dorsal hairs on A7; three pairs of long dark brown and one pair of shorter dark brown dorsolateral hairs on A8-A10; yellowish green, reddish brown dorsally on T1 and A1-A3 and A7-A10; head, prothoracic and anal plates black.

Hypochrysops hippuris nebulosis

Egg (Fig. 3). A flattened sphere, with closely spaced oblique ridges forming small deep diamond-shaped cells, with short spines, micropylar area sunken; pale green. Diameter 1.0 mm including spines.

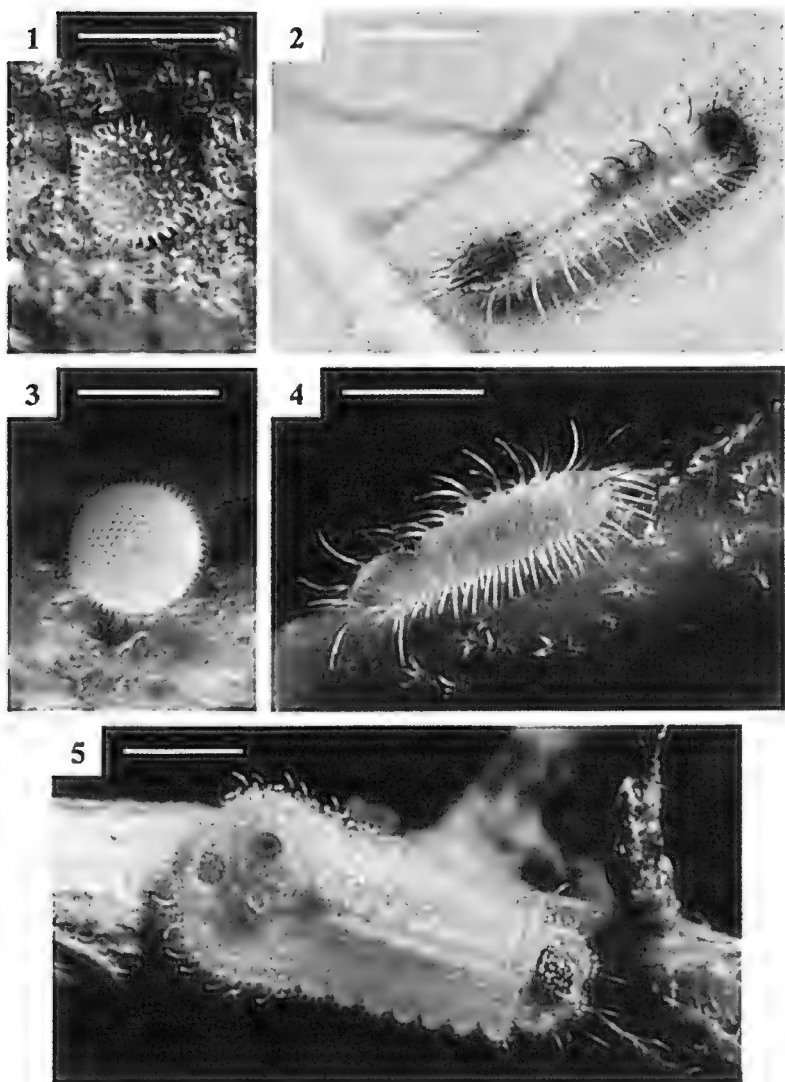
First instar (Fig. 4). T1 with colourless marginal hairs; T2-A7 each with three pairs of long colourless lateral hairs; A8-A10 with long colourless marginal hairs; each segment with one pair of colourless ventrolateral hairs; prothoracic plate dorsally with two pairs of long greyish hairs; T2-T3 each with two pairs of long colourless dorsal hairs; A1-A6 each with two pairs of dorsal hairs, the outer pair short, greyish on A6 but otherwise colourless, the inner pair long and colourless on A1-A3, short and colourless on A4-A5 and long dark grey and held together medially on A6; numerous pairs of short colourless dorsal and dorsolateral hairs on A7-A10; pale greenish yellow, a reddish dorsal spot on A6; head pale brown, prothoracic plate body colour, anal plate greyish.

Second instar (Fig. 5). Flattened with scalloped margins, dorsal ridge on T2-A5, A7-A10 broad; colourless anterior and posterior hairs; T2 with one pair of lateral hairs and T2-A3 each with one pair of ventrolateral hairs, all colourless; one pair of colourless dorsal hairs from rear of prothoracic plate; T2-A4 each with one pair of dorsal hairs, brown on A4 but otherwise colourless; dense secondary setae; cream, T1 reddish anteriorly, a reddish dorsal patch on A6-A8; head pale brown, prothoracic plate glossy black, anal plate glossy grey. Newcomer's organ present on A7 and tentacular organs (TOs) present on A8, the area surrounding the TOs large and raised, brown to black.

Third instar. Form similar to second instar, but with additional dorsal hairs including one brown pair on A5; greyish white with reddish brown at front of T1, dorsally on A6-A8 and in subdorsal band on T2-A6, a white lateral line, spiracles black.

Life history notes

I found eggs of *H. e. barnardi* singly beneath leaves of *Nauclea orientalis* (Rubiaceae), in feeding scars, necrotic areas or on healthy green tissue. Only a few eggs were found on branches; they may have been more numerous but were much harder to see than on the leaves. The incubation time is uncertain as the date of oviposition was unknown, but must be at least 6 days as that was the time that elapsed until hatching of some field-collected eggs. First instar larvae of *H. e. barnardi* were also found beneath leaves, usually with one or two ants, *Philidris cordatus stewartii* (Forel), on the leaf. Small larvae skeletonised the underside of leaves, but in later instars they ate holes through the leaves as described by Samson *et al.* (1997). Six larvae of *H. e. barnardi* were reared at Mackay under ambient conditions. All passed through seven instars. Mean durations of successive instars were 7 d, 6 d, 6 d, 7 d, 7 d, 10 d and 16 d ($n = 5$ or 6); the mean larval development time was 60 d ($n = 4$).



Figs 1-5. *Hypochrysops elgneri barnardi*: (1) egg; (2) first instar larva, head at right. *H. hippuris nebulosis*: (3) egg; (4-5) first and second instar larvae, head at right. Scale bars = 1 mm; Figs 1-4 to same scale.

Re-examination of the preserved specimen of *H. e. barnardi* photographed and described by Samson *et al.* (1997) as an 'early instar' showed it to be a second instar, by the presence of hairs on the prothoracic plate. These hairs are absent in later instars.

I found eggs of *H. h. nebulosis* by watching a female at a small spindly tree bearing *Pyrrosia* sp. fern (Polypodiaceae) along its trunk and two branches. There were also several small ant-plants (*Myrmecodia* sp., Rubiaceae) on the tree, with associated ants (*Philidris cordatus*). The female would land on the fern blades, then crawl down towards their base and on to the branch, probing with her abdomen. After appearing to oviposit she would fly a short distance to land on the same or an adjacent tree, but then return. Four eggs appeared to be laid during about 1 hour of observation from around midday. The tree was then examined and four eggs were found, one on the petiole at the base of a fern blade, two on fern rhizome and one beneath debris near the rhizome. Other eggs, mostly hatched, were subsequently found on ferns on other trees. The majority of eggs were laid on the slender rhizome, often partly hidden between the rhizome and the supporting branch, but a few eggs were found on fern blades. All were laid singly.

The newly laid eggs hatched in 8 days. The first two larval instars mostly rested on and fed on the rhizome, grazing the surface or chewing deep pits in the soft tips. However, one larva fed on fern blades in the first instar. By the third or fourth instars feeding seemed to be only on the blades, with larvae eating windows in one surface as illustrated by Johnson and Valentine (2001). One larva of *H. h. nebulosis* passed through six instars from hatching to pupation; several other larvae died during rearing. The mean duration of successive instars was 9 d (n = 4), 9 d (n = 4), 8 d (n = 2), 7 d (n = 2), 7 d (n = 2) and 11 d (n = 1); the larval period of the individual that pupated occupied 51 d.

The description of 'third instar larvae' provided by Johnson and Valentine (2001) differs from mine, and their illustration of a 'fourth instar larva' matches my observations of fifth instars. The discrepancy is explained by those authors having assumed that there were only five larval instars and working backwards from pupation to estimate stage of development (S. Johnson, pers. comm.).

Acknowledgement

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A STRIKING NEW SUBSPECIES OF *HYPOLIMNAS PITHOEKA* KIRSCH (LEPIDOPTERA: NYMPHALIDAE) FROM THE TORRES ISLANDS, NORTHERN VANUATU

W. JOHN TENNENT

Biogeography and Conservation Laboratory, Department of Entomology, The Natural History Museum, London SW7 5BD, UK

(address for correspondence: 38 Colin McLean Road, Dereham, Norfolk NR19 2RY, UK)

Abstract

Hypolimnas pithoea impostor subsp. nov. is described from the Torres group of islands in northern Vanuatu. It is compared with other subspecies of *H. pithoea* Kirsch and with *H. octocula* Butler. Its mimetic resemblance to *Euploea leucostictos* Gmelin is discussed.

Introduction

Hypolimnas pithoea Kirsch occurs, in a number of described subspecies, from the main island of New Guinea eastwards through the Solomon archipelago to Vanuatu. On islands of the Solomon archipelago, *H. pithoea* is a member of resident nymphalid mimicry complexes. The female of its congener *H. misippus* Linnaeus is said to be a remarkably close mimic of *Danaus chrysippus* Linnaeus. Subspecies of *H. pithoea*, while less colourful or dramatic, are equally accurate mimics of brown species of *Euploea* Fabricius.

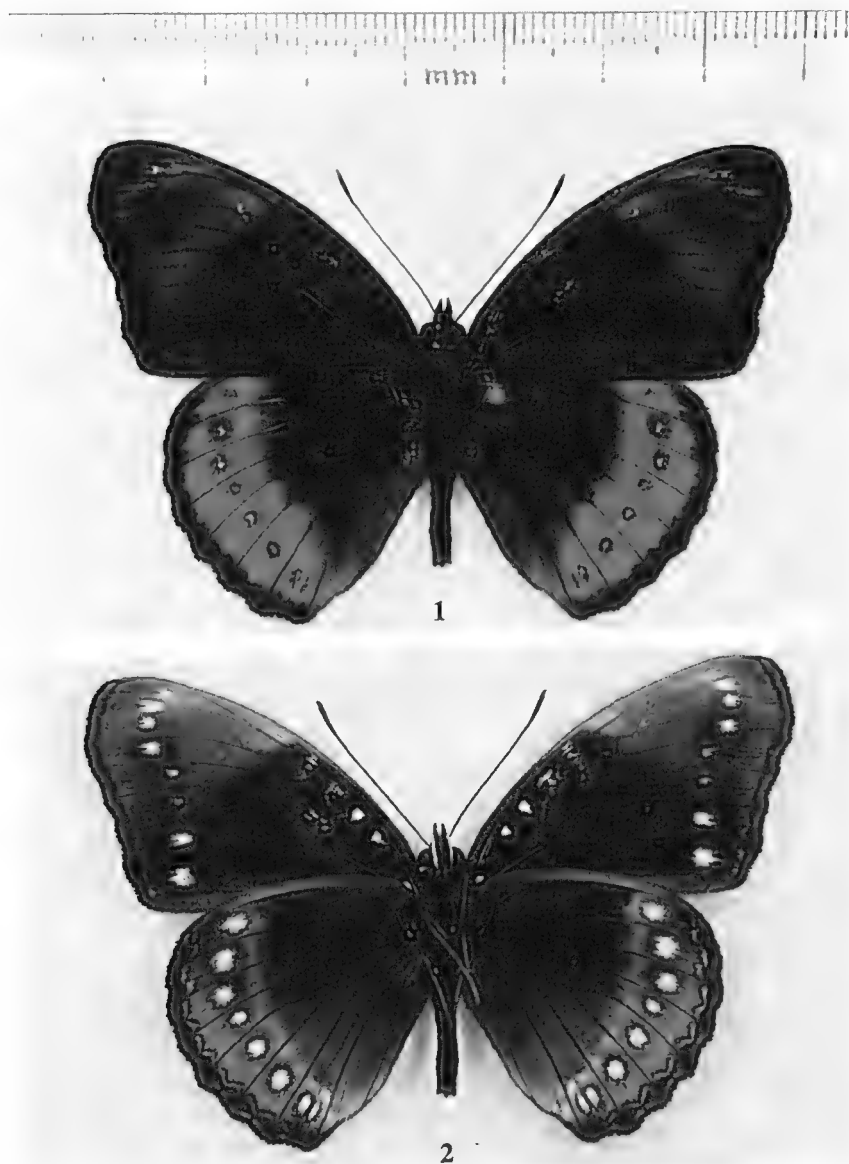
H. pithoea was first recorded from Vanuatu by Gross (1975), who reported it from the islands of Efaté and Erromango. Samson (1979) reported nominotypical *H. pithoea* from the 'New Hebrides' and later (Samson 1983, 1986) recorded '*H. pithoea* subsp.' from Efaté. The present author is not aware of any specimens of *H. pithoea* from Vanuatu in any museum or private collection. Tennent (2001a) suggested the possibility that Vanuatu specimens may be referable to *H. p. leveri* Tennent, described from the Santa Cruz group of islands (Solomon Islands). This is not the case. During a brief visit to the Torres group of islands in northern Vanuatu in September 2000, a short series of *H. pithoea*, representing an undescribed subspecies, was collected on Loh Island.

***Hypolimnas pithoea impostor* subsp. nov.**

(Figs 1-4)

Types. Holotype ♂, VANUATU: Torres group, Loh Island, between Lunghariki and Rinjha villages, SL-20 m, 6.ix.2000, W.J. Tennent (in The Natural History Museum [BMNH], London). *Paratypes*: 1 ♂, 1 ♀, same data as holotype (♂ gen. prep BMNH(V) 5979); 1 ♂, 1 ♀, same data as holotype but 7.ix.2000 (♂ gen. prep BMNH(V) 5980); 4 ♀♀, same data as holotype but 3.ix.2000, 4.ix.2000, 8.ix.2000 or 10.ix.2000 (all BMNH).

Description. Male (Figs 1-2). Forewing length 35 mm; upperside markings with some superficial resemblance to *H. p. ferruginea* Howarth from Bellona Island and *H. octocula* from the northern and central islands of Vanuatu.



Figs 1-2. *Hypolimnast pithoea impostor* subsp. nov., holotype male: (1) upperside; (2) underside.



Figs 3-4. *Hypolimnias pithoea impostor* subsp. nov., paratype female: (3) upperside; (4) underside.

Forewing dark brown, with an indistinct and obscure dull red postdiscal band and subapical markings (variable: the holotype [Fig. 1] is intermediate) (forewing unmarked in *H. p. ferruginea*; forewing generally with a broad, clear orange postdiscal band in *H. octocula*); 2-4 tiny white subapical spots; hindwing with a broad, dull orange submarginal band, enclosing a full series of white-pupilled black spots (band duller and spots incomplete, not white-pupilled in *H. p. ferruginea*; band narrower, brighter, and spots not white-pupilled in *H. octocula*); underside various shades of brown with obscure pale orange-yellow submarginal band enclosing a full series of black submarginal spots almost completely filled with prominent, white centres (underside without band in *H. p. ferruginea*; band usually distinct and white centres less prominent in *H. octocula*). Genitalia typical of *H. pithoea*.

Female (Figs 3-4) superficially similar to other subspecies of *H. pithoea*, in particular *H. p. ferruginea* and *H. p. leverii* (from Santa Cruz Islands); upperside plain brown; forewing with a curved subapical series of white spots and a prominent (see discussion) 'double' spot above inner margin; hindwing with an irregular submarginal series of pale blue markings (lacking in other subspecies of *H. pithoea*) and an obscure orange-brown broad submarginal band enclosing black spots with large white pupils; underside shades of brown; forewing with a full series of submarginal white spots; hindwing with a barely discernible pale submarginal band enclosing a full series of black spots prominently filled with white.

Distribution. The Torres group (Loh Island), northern Vanuatu.

Etymology. The subspecific name *impostor* is derived from its deceptive resemblance to *Euploea leucostictos*.

Discussion

The author has observed *H. pithoea* on many islands of the Solomon archipelago, including the western and central islands (*H. p. pithoea*), Rennell (*H. p. bradleyi* Howarth), Bellona (*H. p. ferruginea*), Malaita (*H. p. scopas* Godman & Salvin) and the Santa Cruz group (*H. p. leverii*). Although widespread, it is seldom common and individuals of both sexes are usually found in company with greater numbers of resident *Euploea* species, which they resemble both in phenotype and flight pattern. They thus obtain a measure of protection due to the unpalatability of the danaine butterflies. With experience, *H. pithoea* can usually be identified on the wing, although this may not be possible until an individual comes to rest, usually quite suddenly and without hesitation on the upper or under surface of a leaf, with wings closed. *Euploea* species rest in the same position but almost always investigate a suitable resting place by hesitating before landing, sometimes for quite a prolonged period. Males of some subspecies (e.g. *H. p. bradleyi* and *H. p. leverii*) also occasionally rest in typical nymphaline fashion, with wings spread flat, a posture rarely adopted by their danaine models.

A male *Hypolimnias* Hübner species seen (but not secured) on Loh Island feeding at the flowers of *Mikania* (Asteraceae) initially was thought to be *H. octocula*, not recorded from the Torres group, on account of its prominent orange bands. The following day, a butterfly which appeared similar in all respects to *Euploea leucostictos* Gmelin was observed at close quarters flying in an overgrown village garden and initially was ignored. It was not until the individual came to rest suddenly on the upperside of a leaf that the underside markings clearly identified it as a species of *Hypolimnias*. The white submarginal mark above the margin on the upperside of the forewing in female *H. pithoea* and the prominent median spot on both surfaces of the forewing in male *E. leucostictos*, bear little resemblance when viewed on set specimens. In flight, however, this female *H. pithoea* (Fig. 3) appeared very similar to *E. leucostictos* and this presumably affords some protection from potential predators. When a male was eventually captured, it was clear from the shape of the forewing, longer and narrower than that of *H. octocula*, that this was also *H. pithoea*.

The male of *H. pithoea impostor* closely resembles that of *H. octocula* from the southern islands of Vanuatu, where it is apparently very variable and often has the orange forewing band reduced or absent (Samson 1986). On the central islands (e.g. Espiritu Santo, Malakula, Efaté), *H. octocula* is less variable. There appears to be some faunal discontinuity between the Torres Islands and the Santa Cruz group (Solomon Islands) to the north and between the Torres Islands and the Banks group to the south-east (c.f. *Papilio fuscus* Goeze: Tennent 2001b) and this is currently under investigation.

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